WHAT IS CLAIMED IS:

Sub A1

1. A method of producing a semiconductor member, comprising the steps of:

forming a porous layer in a surface region of a first substrate;

forming a semiconductor layer on the porous layer by liquid phase epitaxy;

bonding a second substrate to a surface of the semiconductor layer opposite to a semiconductor layer surface bonded to the first substrate; and

separating the first substrate from the semiconductor layer by utilizing the porous layer to transfer the semiconductor layer to the second substrate.

2. A method according to claim 1, wherein the semiconductor layer is formed on the porous layer, the semiconductor layer comprising a region formed by vapor phase epitaxy and a region formed by the liquid phase epitaxy in this order.

3. A method according to claim 1, further comprising a step of removing the porous layer remaining on the surface of the first substrate after the first substrate is separated from the semiconductor layer.

Sub B1

4. A method according to claim 1, wherein the liquid phase epitaxy is conducted using a melting solution in which elements for forming the semiconductor layer to be grown are dissolved up to a supersaturated state or a substantially supersaturated state.

5. A method according to claim 1, wherein the liquid phase epitaxy is conducted under a reducing atmosphere.

6. A method according to claim 1, wherein the liquid phase epixtaxy includes that a melting solution in which elements for forming the semiconductor layer to be grown are dissolved is brought in contact with the porous layer.

Sub B37

7. A method according to claim 1, wherein the liquid phase epixtaxy includes that a melting solution in which elements for forming the semiconductor layer to be grown are dissolved is brought in contact with an epitaxial layer formed on the porous layer.

8. A method according to claim 7, wherein the epitaxial layer is formed by vapor phase epitaxy.

9. A method according to claim 1, wherein the

~~liquid phase epitaxy includes that a melting solution in which elements for forming the semiconductor layer to be grown are dissolved upto a desired concentration is used and the melting solution is brought in contact with a surface of the porous layer while a surface temperature of the porous layer is made lower than a temperature at which the elements in the melting solution having the desired concentration are saturated.~~

~~10. A method according to claim 2, wherein the vapor phase epitaxy is conducted by decomposing a source gas while supplying a gas for forming a reducing atmosphere.~~

~~11. A method according to claim 1, wherein the step of bonding the second substrate is conducted using an adhesive.~~

~~12. A method according to claim 11, wherein the adhesive comprises a water-soluble adhesive.~~

Sub B47

~~13. A method according to claim 1, further comprising a step of providing a third substrate on a separate surface for transferring the semiconductor layer to the second substrate.~~

14. A method according to claim 13, further comprising a step of separating the second substrate to transfer the semiconductor layer onto the third substrate.

15. A method according to claim 1, wherein the second substrate has a water permeability.

16. A method according to claim 14, wherein the separation of the second substrate is conducted by the deterioration of adhesion of the adhesive used for bonding of the second substrate.

17. A method according to claim 16, wherein the deterioration of the adhesion is conducted by a liquid that has passed through the second substrate.

18. A method according to claim 16, wherein the adhesive is water-soluble, and the deterioration of the adhesion is conducted by a water that permeates the second substrate.

19. A method according to claim 1, wherein an impurity in the porous layer is diffused into the semiconductor layer.

20. A method according to claim 1, wherein the

liquid phase epitaxy is conducted with indium as a solvent.

Sub A2

21. A method of producing a solar cell, comprising the steps of:

forming a porous layer in a surface region of a first substrate;

forming a semiconductor layer on the porous layer by liquid phase epitaxy;

bonding a second substrate to a surface of the semiconductor layer opposite to a semiconductor layer surface bonded the first substrate; and

separating the first substrate from the semiconductor layer by utilizing the porous layer to transfer the semiconductor layer to the second substrate.

22. A method according to claim 21, wherein the semiconductor layer is formed on the porous layer, the semiconductor layer comprising a region formed by vapor phase epitaxy and a region formed by liquid phase epitaxy in this order.

Sub B47

23. A method according to claim 21, further comprising a step of removing the porous layer remaining on the surface of the first substrate after the first substrate is separated from the semiconductor

layer.

24. A method according to claim 21, wherein the liquid phase epitaxy is conducted using a melting solution in which elements for forming the semiconductor layer to be grown are dissolved up to a supersaturated state or a substantially supersaturated state.

25. A method according to claim 21, wherein the liquid phase epitaxy is conducted under a reducing atmosphere.

26. A method according to claim 21, wherein the liquid phase epixtaxy includes that a melting solution in which elements for forming the semiconductor layer to be grown are dissolved is brought in contact with the porous layer.

Sub B7

27. A method according to claim 21, wherein the liquid phase epixtaxy includes that a melting solution in which elements for forming the semiconductor layer to be grown are dissolved is brought in contact with an epitaxial layer formed on the porous layer.

28. A method according to claim 27, wherein the epitaxial layer is formed by vapor phase epitaxy.

Sub A3

29. A method according to claim 21, wherein the liquid phase epitaxy includes that a melting solution in which elements for forming the semiconductor layer to be grown are dissolved upto a desired concentration is used and the melting solution is brought in contact with a surface of the porous layer while a surface temperature of the porous layer is made lower than a temperature at which the elements in the melting solution having the desired concentration are saturated.

30. A method according to claim 22, wherein the vapor phase epitaxy is conducted by decomposing a source gas while supplying a gas for forming a reducing atmosphere.

31. A method according to claim 21, wherein the bonding step of the second substrate is conducted using an adhesive.

32. A method according to claim 31, wherein the adhesive includes a water-soluble adhesive.

33. A method according to claim 21, further comprising a step of providing a third substrate on a separate surface for transferring the semiconductor layer onto the second substrate.

Sub B17

Sub A4

34. A method according to claim 33, further comprising a step of separating thed second substrate to transfer the semiconductor layer onto the third substrate.

35. A method according to claim 21, wherein the second substrate has a water permeability.

36. A method according to claim 34, wherein the separation of the second substrate is conducted by the deterioration of adhesion of the adhesive used for bonding of the second substrate.

37. A method according to claim 36, wherein the deterioration of the adhesion is conducted by a liquid that has passed through the second substrate.

38. A method according to claim 36, wherein the adhesive is water-soluble, and the deterioration of the adhesion is conducted by a water that permeates the second substrate.

39. A method according to claim 21, wherein an impurity in the porous layer is diffused into the semiconductor layer.

40. A method according to claim 21, wherein the

liquid phase epitaxy is conducted with indium as a solvent.

Sub A5

41. A method according to claim 21 wherein before the bonding of the second substrate, an impurity is introduced into the semiconductor layer.

42. A method according to claim 21 wherein before the bonding of the second substrate, an impurity is introduced into the semiconductor layer to form a p-n junction.

43. A method according to claim 21 wherein the second substrate has an electroconductive surface.

44. A method according to claim 21, further comprising a step of removing the porous layer remaining on the transferred semiconductor layer.

45. A method according to claim 21, further comprising a step of forming an electrode on the transferred semiconductor layer.

46. A method according to claim 21, further comprising a step of introducing an impurity into the transferred semiconductor layer.

47. A method according to claim 21, further comprising a step of forming a semiconductor layer containing an impurity on the transferred semiconductor layer.

48. A method according to claim 3, further comprising a step of forming a semiconductor layer by conducting epitaxial growth on the substrate from which the porous layer is removed.

49. A method according to claim 48, wherein the semiconductor layer formed by conducting epitaxial growth has p-type or n-type conductivity.

50. A method according to claim 23, further comprising a step of forming a semiconductor layer by conducting epitaxial growth on the substrate from which the porous layer is removed.

51. A method according to claim 50, wherein the semiconductor layer formed by conducting epitaxial growth has p-type or n-type conductivity.

52. A method of producing a semiconductor member, the method comprising the steps of:

Sub B1 (a) forming a porous layer in a surface region of a first substrate;

(b) immersing the porous layer into a melting solution in which elements for forming a semiconductor layer to be grown is dissolved up to a supersaturated state or a substantially supersaturated state under a reducing atmosphere to grow a semiconductor layer on a surface of the porous layer;

(c) bonding a second substrate onto a surface side of the first substrate on which at least the porous layer and the semiconductor layer are formed; and

(d) separating the first substrate from the second substrate at the porous layer to transfer the semiconductor layer separated from the first substrate to the second substrate.

53. A method of producing a semiconductor member according to claim 52, wherein a surface of the first substrate separated in the step (d) is treated and then again subjected to the step (a) as the first substrate.

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54. A method of producing a semiconductor member claimed according to claim 52, wherein after a surface of the first substrate separated in the step (d) is treated, a semiconductor layer into which an impurity is introduced by liquid phase growth is allowed to grow on the surface of the first substrate, and then again subjected to the step (a) as the first substrate.

55. A method of producing a semiconductor member according to claim 54, wherein prior to the formation of the semiconductor layer in which the impurity is introduced, a semiconductor layer into which no impurity is introduced or impurity is introduced with a small concentration is formed on the surface of the first substrate after being subjected to the surface treatment.

Sub C1 Cont

56. A method of producing a semiconductor member according to claim 54, wherein semiconductor having a purity of 99.99% or less is used as the first substrate.

57. A method of producing a semiconductor member, the method comprising the steps of:

(a) forming a porous layer in a surface region of a first substrate;

Sub B27

(b) immersing, into a melting solution in which elements for forming a semiconductor layer to be grown is dissolved up to a desired concentration, the porous layer whose surface temperature is made lower than a temperature at which the melting solution having the desired concentration is saturated, to grow a semiconductor layer on a surface of the porous layer;

(c) bonding a second substrate onto a surface side of the first substrate on which at least the porous

layer and the semiconductor layer are formed; and

(d) separating the first substrate from the second substrate at the porous layer to transfer the semiconductor layer separated from the first substrate to the second substrate.

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58. A method of producing a semiconductor member according to claim 57, wherein a surface of the first substrate separated in the step (d) is treated and then again subjected to the step (a) as the first substrate.

59. A method of producing a semiconductor member according to claim 57, wherein after a surface of the first substrate separated in the step (d) is treated, a semiconductor layer into which an impurity is introduced by liquid phase growth is allowed to grow on the surface of the first substrate, and then again subjected to the step (a) as the first substrate.

60. A method of producing a semiconductor member according to claim 59, wherein prior to the formation of the semiconductor layer in which the impuritiy is introduced, a semiconductor layer into which no impurity is introduced or an impurity is introduced with a small concentration is formed on the surface of the first substrate after being subjected to the surface treatment.

61. A method of producing a semiconductor member according to claim 59, wherein semiconductor having a purity of 99.99% or less is used as the first substrate.

Sub C1 Cont

62. A method of producing a semiconductor member according to claim 52, wherein the first substrate is crystalline.

63. A method of producing a semiconductor member according to claim 52, wherein the first substrate is made of silicon single-crystal.

64. A method of producing a solar cell, comprising a step of using the semiconductor layer transferred to the second substrate which is obtained by the method of claim 52.

65. A method of producing a semiconductor member according to claim 57, wherein the first substrate is crystalline.

66. A method of producing a semiconductor member according to claim 57, wherein the first substrate is made of silicon single-crystal.

67. A method of producing a solar cell,

comprising a step of using the semiconductor layer transferred onto the second substrate which is obtained by the method of claim 57.

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68. A method of producing a semiconductor member, the method comprising the steps of:

(a) forming a porous layer in a surface region of a first crystalline substrate;

(b) growing a first thin-film semiconductor layer on a surface of the porous layer in vapor phase by decomposing a source gas;

(c) immersing the first thin-film semiconductor layer into a melting solution in which elements for forming a second thin-film semiconductor are dissolved up to a saturated state or a supersaturated state under a reducing atmosphere to grow a second thin-film semiconductor layer of a conductive type different from that of the first thin-film semiconductor layer on a surface of the first thin-film semiconductor layer in liquid phase;

(d) bonding a second substrate onto a surface of the second thin-film semiconductor layer or onto a surface of a layer further formed on the second thin-film semiconductor layer;

(e) separating the first thin-film semiconductor layer from the first substrate by exerting a force on the porous layer to transfer the first thin-film

semiconductor layer to the second substrate.

69. A method of producing a semiconductor member according to claim 68, wherein the step of bonding the second substrate is conducted by using an adhesive.

70. A method of producing a semiconductor member according to claim 69, wherein the adhesive is a water-soluble adhesive.

71. A method of producing a semiconductor member according to claim 68, further comprising the steps of:

bonding a third substrate onto a separation surface of the substrate; and

separating the thin-film semiconductor layer from the second substrate to transfer the thin-film semiconductor layer to the third substrate.

72. A method of producing a semiconductor member according to claim 68, wherein the second substrate has a water permeability.

73. A method of producing a semiconductor member according to claim 71, wherein the step of separating the thin-film semiconductor layer bonded with an adhesive from the second substrate to transfer the thin-film semiconductor layer to the third substrate is

conducted by lowering adhesion of the adhesive.

74. A method of producing a semiconductor member according to claim 71, wherein the step of separating the thin-film semiconductor layer bonded with an adhesive from the second substrate to transfer the thin-film semiconductor layer to the third substrate is conducted by lowering adhesion of the adhesive through the second substrate.

75. A method of producing a semiconductor member according to claim 71, wherein the step of separating the thin-film semiconductor layer from the second substrate to transfer the thin-film semiconductor layer to the third substrate is conducted by adding a water to the second substrate having a water permeability to lower adhesion of the adhesive.

76. A method of producing a semiconductor member according to claim 71, wherein the step of separating the thin-film semiconductor layer bonded with a water-soluble adhesive from the second substrate to transfer the thin-film semiconductor layer to the third substrate is conducted by adding a water to the water-soluble adhesive to lower adhesion of the adhesive.

77. A method of producing a semiconductor member

according to claim 71, wherein the step of separating the thin-film semiconductor layer bonded with a water-soluble adhesive from the second substrate having a water permeability to transfer the thin-film semiconductor layer to the third substrate is conducted by adding a water to the water-soluble adhesive through the second substrate having a water permeability to lower adhesion of the adhesive.

78. A method of producing a semiconductor member according to claim 68, further comprising a step of treating a surface of the first substrate after being subjected to the speration and then reusing the treated first substrate.

79. A method of producing a semiconductor member according to claim 78, further comprising, after the surface of the first substrate from which the first thin-film semiconductor layer has been separated is treated, a step of growing a semiconductor layer having the same composition as that of the first substrate and doped with an impurity on the surface of the first substrate in liquid phase, and then repeating the steps (a) to (e).

80. A method of producing a semiconductor member according to claim 79, further comprising, prior to the

formation of the semiconductor layer doped with the impurity, a step of forming a semiconductor layer doped with no impurity or doped with a small content of an impurity on the treated surface of the first substrate by liquid phase growth, and then repeating the steps (a) to (e).

81. A method of producing a semiconductor member according to claim 68, wherein semiconductor having a purity of 99.99% or less is used as the first substrate.

82. An apparatus of producing a semiconductor member in which a substrate comprising a porous layer is stored and a semiconductor layer is formed on the porous layer, the apparatus comprising:

a liquid phase growth vessel for immersing a first thin-film semiconductor layer into a melting solution in which elements for forming a second thin-film semiconductor layer are dissolved up to a saturated state or a supersaturated state under a reducing atmosphere to grow a second thin-film semiconductor layer on a surface of the first thin-film semiconductor layer in liquid phase; and

means for conveying the substrate between a vapor phase growth vessel and the liquid phase growth vessel while keeping the reducing atmosphere.

Sub C1 Cont

83. An apparatus according to claim 82, further comprising a vapor phase growth vessel disposed in front of the liquid phase growth vessel, for decomposing a source gas in the reducing atmosphere to grow the first thin-film semiconductor layer on a porous layer surface of the substrate in vapor phase.

~~84. A method of producing a solar cell by using the method of claim 68 of producing the semiconductor member.~~

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85. An apparatus of producing a solar cell in which a substrate comprising a porous layer is stored and a semiconductor layer is formed on the porous layer, the apparatus comprising:

a liquid phase growth vessel for immersing a first thin-film semiconductor layer into a melting solution in which elements for forming a second thin-film semiconductor layer are dissolved up to a saturated state or a supersaturated state under a reducing atmosphere to grow a second thin-film semiconductor layer having a different conductivity type from that of the first thin-film semiconductor layer on a surface of the first thin-film semiconductor layer in liquid phase; and

means for conveying the substrate between a vapor phase growth vessel and the liquid phase growth vessel

while keeping the reducing atmosphere.

Sub C1 Cont

86. An apparatus according to claim 85, further comprising a vapor phase growth vessel disposed in front of the liquid phase growth vessel, for decomposing a source gas in the reducing atmosphere to grow the first thin-film semiconductor layer on a porous layer surface of the substrate in vapor phase.

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